



# UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office  
Address: COMMISSIONER FOR PATENTS  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/848,985	05/18/2004	Eugene P. Marsh	2002-0717.01/US	5986
7590	01/05/2006		EXAMINER TSAI, H JEY	
Kevin D. Martin Micron Technology, Inc. MS 1-525 8000 S. Federal Way Boise, ID 83716			ART UNIT 2812	PAPER NUMBER
DATE MAILED: 01/05/2006				

Please find below and/or attached an Office communication concerning this application or proceeding.

<b>Office Action Summary</b>	<b>Application No.</b> 10/848,985	<b>Applicant(s)</b> MARSH ET AL.	
	<b>Examiner</b> H.Jey Tsai	<b>Art Unit</b> 2812	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

#### Status

- 1) ☒ Responsive to communication(s) filed on 21 October 2005.  
 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.  
 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

#### Disposition of Claims

- 4) ☒ Claim(s) 1-26 is/are pending in the application.  
 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.  
 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.  
 6) ☒ Claim(s) 1-26 is/are rejected.  
 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.  
 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

#### Application Papers

- 9) ☐ The specification is objected to by the Examiner.  
 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).  
 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

#### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
 a) ☐ All b) ☐ Some \* c) ☐ None of:  
 1. ☐ Certified copies of the priority documents have been received.  
 2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.  
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).  
 \* See the attached detailed Office action for a list of the certified copies not received.

#### Attachment(s)

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)  | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                                   | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____  |

***Claim Rejections - 35 USC § 112***

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 19-25 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

In claim 19, "the oxide layer" lacks proper antecedent basis. Changing "dielectric layer" to "oxide" layer is suggested.

***Claim Rejections - 35 USC § 102***

The following is a quotation of the appropriate paragraphs of 35 U.S.C. § 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless --

(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claim 1 is rejected under 35 U.S.C. § 102(b) as being anticipated by Sashida et al. 2001/0012659.

Sashida et al. discloses a method of adhering a ruthenium metal layer to an oxide layer of a semiconductor, the method comprising:

Art Unit: 2812

exposing the oxide layer 6 to a silicon-containing gas of silane, para. 72, and fig. 5B,

after exposing the oxide layer 6 to the silicon containing gas,

forming the ruthenium metal layer 17 to contact the oxide layer 6, para. 58.

Claim 1 is rejected under 35 U.S.C. § 102(b) as being anticipated by Fujii et al. 6,053,791.

Fujii et al. discloses a method of forming a ruthenium layer to an oxide layer of a semiconductor, the method comprising:

exposing the oxide layer (an insulating layer of oxide formed on the substrate, see fig. 19, 15D, 11 and col. 11, lines 52-55) to a silicon-containing silane gas to convert a surface termination of the oxide layer from a hydroxyl-terminated surface to a hydrogen-terminated surface,

exposing the oxide layer (insulating layer is oxide layer, see col. 7, lines 52-53) to the silicon-containing silane gas,

forming the ruthenium metal layer 4 (metal layer 4 can be Pd, Ru, ....., see col. 8, lines 10-17) to contact the oxide layer, col. 11, lines 56-62, and fig. 19B.

### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

Art Unit: 2812

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 4-6 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fujii et al. 6,053,791 in view of Terbrueggen et al. 2004/0053290.

The reference(s) teach the features :

Fujii et al. discloses a method of forming a ruthenium layer to an oxide layer of a semiconductor, the method comprising:

exposing the oxide layer (an insulating layer of oxide formed on the substrate, see fig. 19, 15D, 11 and col. 11, lines 52-55) to a silicon-containing silane gas to convert a surface termination of the oxide layer from a hydroxyl-terminated surface to a hydrogen-terminated surface,

exposing the oxide layer (insulating layer is oxide layer, see col. 7, lines 52-53) to the silicon-containing silane gas,

forming the ruthenium metal layer 4 (metal layer 4 can be Pd, Ru, ..., see col. 8, lines 10-17) to contact the oxide layer, col. 11, lines 56-62, and fig. 19B.

The difference between the reference(s) and the claims are as follows: Fujii et al. teaches exposing the oxide layer with silane to form a hydrophobic surface before forming a ruthenium layer but does not teach that replacing the O-H bond of the oxide surface with hydrogen of silane ( $\text{SiH}_4$ ) to become a hydrophobic surface. However, Terbrueggen et al. teaches at para. 172, the hydrophobic oxide surface is due to the replacement of O-H bond of oxide layer with silane gas. And, the specific waiting time

Art Unit: 2812

before depositing the ruthenium layer as claimed are taken to be obvious since these are variables of art recognized importance which are subject to routine experimentation and optimization and discovery of an optimum value for a known process is obvious. In *re Aller*, 105 USPQ 233 (CCPA 1955). And, even if applicants' modification results in great improvement and utility over the prior art, it may still not be patentable if the modification was within the capabilities of one skilled in the art, In *Re Sola* 25 USPQ 433.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have recognized that hydrophobic oxide surface is due to the replacement of O-H bond in the oxide layer with silane gas (Si-H, SiH<sub>4</sub>) as suggested by Terbrueggen et al. and using a specific waiting time before forming a ruthenium layer on the exposed oxide surface so that hydrogen containing silane gas has sufficient to react with the oxide surface.

Claim 2-3 are rejected under 35 U.S.C 103 as being unpatentable over Sashida et al. as applied to claim 1 above, and further in view of Skill level of one of ordinary skill in the art.

The difference between the references applied above and the instant claim(s) is: Sashida et al. teaches exposing the oxide layer to silane gas but does not teach the waiting time before the deposition of ruthenium layer. However, the specific waiting time before depositing the ruthenium layer as claimed are taken to be obvious since these are variables of art recognized importance which are subject to routine

Art Unit: 2812

experimentation and optimization and discovery of an optimum value for a known process is obvious. In re Aller, 105 USPQ 233 (CCPA 1955). And, even if applicants' modification results in great improvement and utility over the prior art, it may still not be patentable if the modification was within the capabilities of one skilled in the art, In Re Sola 25 USPQ 433.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the above references' teachings by waiting a specific time before depositing the ruthenium layer after exposing the dielectric layer to the silane gas because using a specific the waiting time is within the skill level of one of ordinary skill in the art so that that there is sufficient time for silane to react with the oxide layer.

Claims 7-26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kuo iwa et al. 6,187,622 in view of Sashida et al. 2001/0012659.

The reference(s) teach the features :

Kuo iwa et al. discloses a method of forming a ruthenium layer to an oxide layer of a semiconductor, the method comprising:

Placing the wafer in the CVD process chamber, col. 8, lines 30-67,

Flowing SiH<sub>4</sub> silane gas into the chamber,

exposing an insulating layer 110 formed on the substrate to the silicon-containing silane gas

Art Unit: 2812

flowing a ruthenium metal precursor into the chamber to form ruthenium metal layer 114 (metal layer 114 is a CVD process with Ru) on the insulating layer, col. 8, lines 66-67, col. 11, lines 58-63,

ruthenium metal precursor is bis(cyclopentadienyl) ruthenium, or a derivative of ruthenocene, col. 11, lines 58-63,

forming a storage capacitor 114/115/116, fig. 6,

forming a planarized dielectric layer, 110, fig. 1,

etching the dielectric layer 110 to expose the contact pad 106b.

The difference between the reference(s) and the claims are as follows: Kuroiwa et al. teaches exposing the inter-layer insulating film to silane ( $\text{SiH}_4$ ) gas but does not teach inter-layer insulating film is an oxide layer. However, Sashida et al. teaches at para. 34, the inter-layer insulating film 4 is an oxide layer. Sashida et al. also teaches at 72 and 57, exposing the metal oxide to silane gas then forming a ruthenium upper electrode layer. And, the specific waiting time before depositing the ruthenium layer, gas flowing time and rate, depositing temperature and time as claimed are taken to be obvious since these are variables of art recognized importance which are subject to routine experimentation and optimization and discovery of an optimum value for a known process is obvious. In re Aller, 105 USPQ 233 (CCPA 1955). And, even if applicants' modification results in great improvement and utility over the prior art, it may still not be patentable if the modification was within the capabilities of one skilled in the art, In Re Sola 25 USPQ 433.



It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified Kuoiwa et al.'s inter-layer insulating film to oxide layer as suggested by Sashida et al. because using oxide material as inter-layer insulating film is well known in the art to form a thicker film on the semiconductor substrate. And, using a specific the waiting time,, gas flowing time and rate and deposition temperature and time are within the skill level of one of ordinary skill in the art so that that there is sufficient time and quantity of silane to react with the oxide layer.

### ***Conclusions***

Terminal disclaimer filed on Oct. 21, 2005 is acknowledged.

The newly cited references teach exposing oxide layer with silane gas then depositing a ruthenium metal layer on the oxide layer are set forth above.

Any inquiry of a general nature or clerical matters or relating to the status of this application or proceeding should be directed to the customer service whose telephone number is (703) 308-4357.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to H. Jey Tsai whose telephone number is (571) 272-1684. The examiner can normally be reached on from 7:00 Am to 4:00 Pm., Monday thru Thursday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael S. Lebentritt can be reached on (571) 272-1873.

The fax phone number for this Group is 571-273-8300.

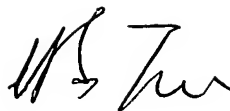
hjt

Application/Control Number: 10/848,985

Page 9

Art Unit: 2812

12/14/2005

A handwritten signature in black ink, appearing to read 'H. Jey Tsai'.

H. Jey Tsai  
Primary Examiner  
Patent Examining Group 2800